

# ***ELPIDA***

***The Power of Focus***

## ***“A Perspective on Future DRAM Technology”***

**Misao Higuchi**

**Director**

**Technical Marketing Division**

**Elpida Memory, Inc.**



**San Jose January 23-24, 2001**



**Taipei February 14-15, 2001**

# *Who is Elpida ...*

**NEC (DRAM) +  
Hitachi (DRAM) =**

***Elpida***

● **Rich heritage from parent companies:**

- *Advanced DRAM process technology*
- *Investment in R&D and capital equipment*
- *Quality, reliability, dependability of products*

● **New company qualities:**

- *Completely dedicated to DRAM, faster shrinks*
- *Support for all major architectures: SDR/DDR/Rambus*
- *Combined resources for technology innovation and larger market presence*

***This is the power of focus!***

# *Corporate Profile*



***Our Mission***  
***High Technologies & Best Sales Practices***

***The Power of Focus***

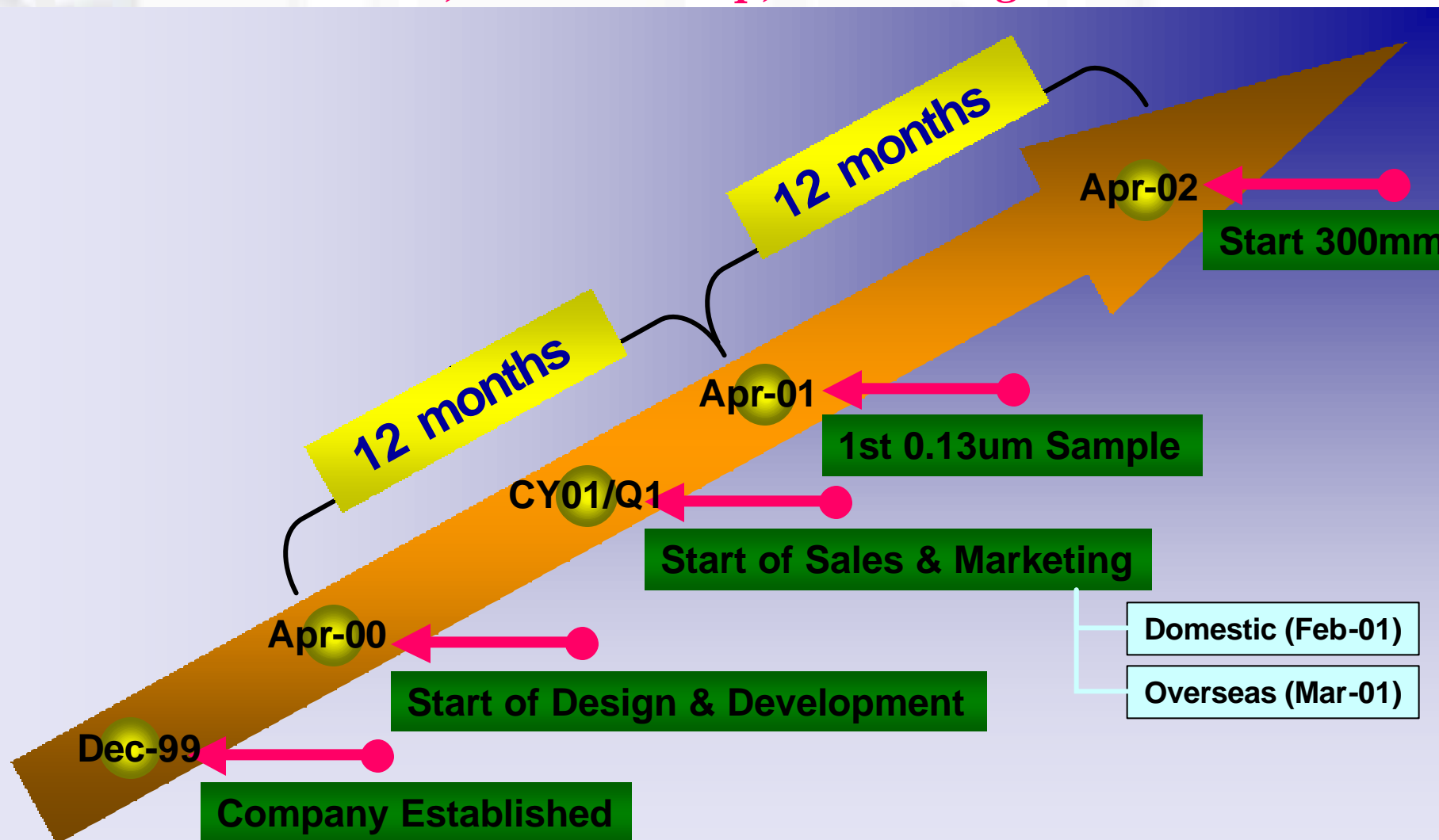
“The company plans to combine the best sales practices with their inherent technology leadership position to service the high-end PC and server markets, as well as the growing market for DRAM in emerging communications platforms.”



**Kenji Tokuyama**  
**President**

# Major Elpida Milestones

## 0.13um, 300mm Ramp, Sales Integration



# *Designing for the Future*

## *Leading-Edge 0.13um Development*

### Summary

- ✍ JEDEC Specification
- ✍ Device Advantages
  - ✍ Flexibility: Metal Option
  - ✍ Performance: Speed & Power
  - ✍ Manufacturing: Smallest Die
- ✍ Start Schedule
  - ✍ ES **Apr-2001**
  - ✍ Production **Oct-2001**

### 256Mb Die (0.13um)



# *Proven Manufacturing Capability*

## *Utilizing NEC & Hitachi Capacity*

**Production**

**CY2001** **CY2002**

**NEC** Hiroshima, UK, Shanghai **ELPIDA**  
**HITACHI** Singapore

**Products**

**NEC** **ELPIDA**  
**HITACHI**

**Sales &  
Marketing**

**ELPIDA**

**Quality**

**ELPIDA**

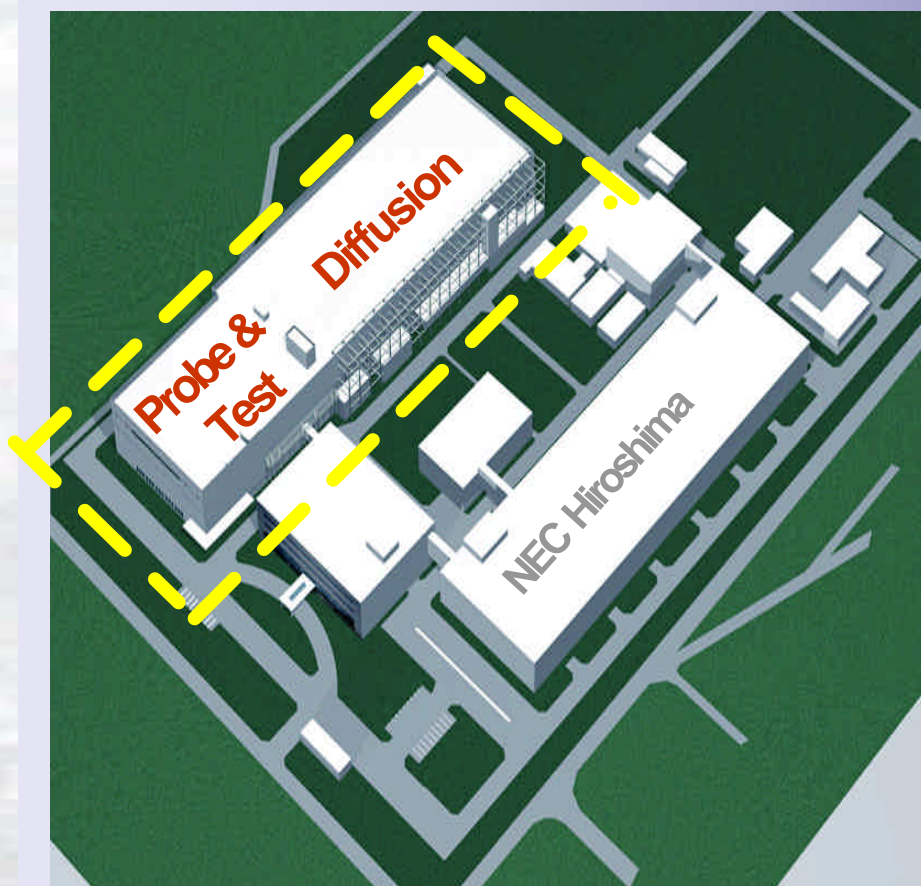
**Design**

**ELPIDA**

# *Investment for the Future*

## *Leading-Edge 300mm Facility*

### 300mm Facility



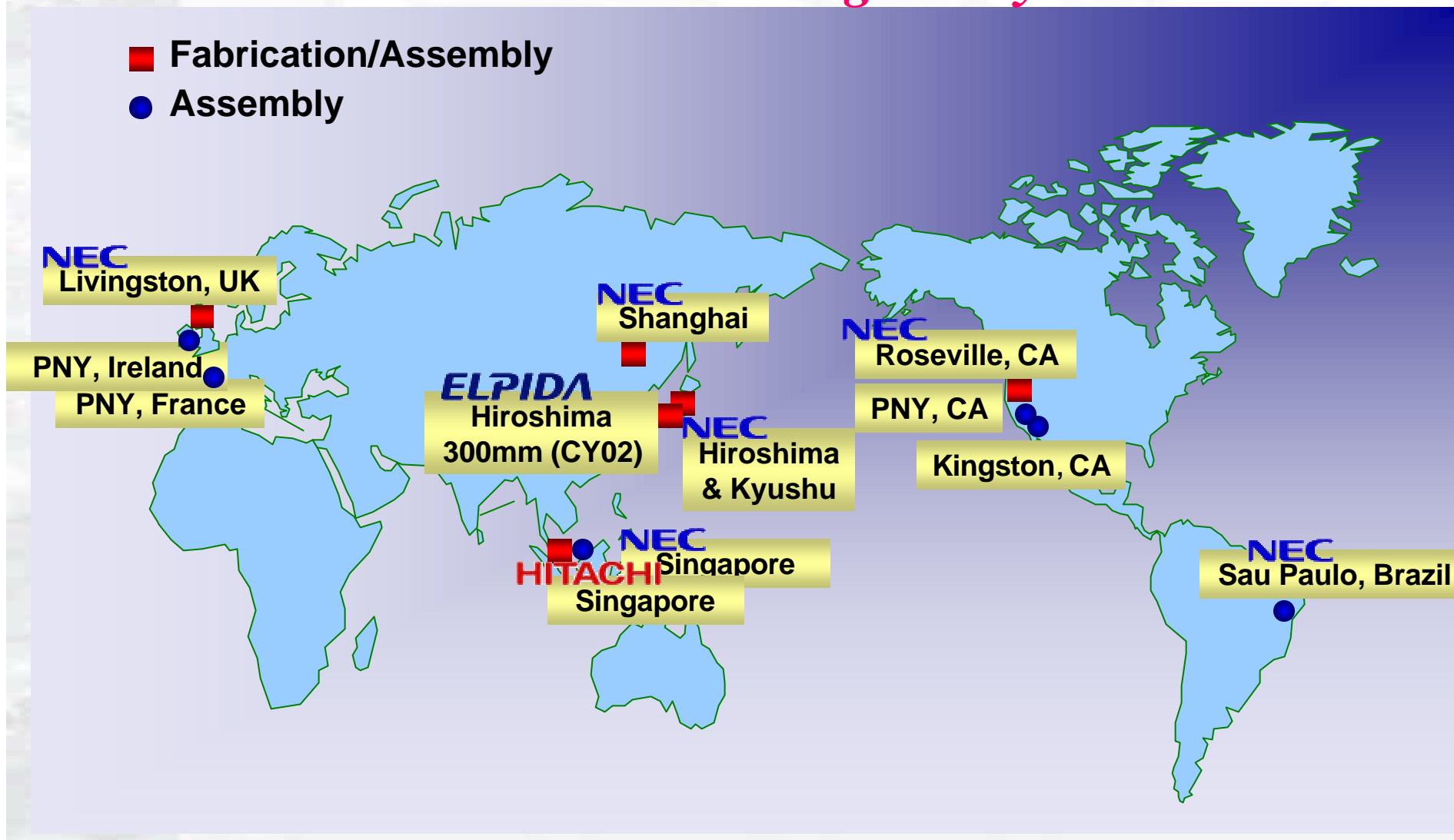
### Summary

- ✍ Location: Hiroshima, Japan
- ✍ Investment: 1.6B Yen
- ✍ Facility Area: 57,500m<sup>2</sup>
- ✍ Capacity: 20k/wafer per mo
- ✍ Lithography: ~0.13um
- ✍ Start Schedule
  - ✍ Construction: **Jan-2000**
  - ✍ Production: **Apr-2002**

# *Global Production Locations*

## *Flexible Worldwide Logistic Systems*

- Fabrication/Assembly
- Assembly





# *Global Sales & Marketing For Local Regional Support*

- Headquarters
- Regional Office



# *Elpida Memory, Inc. Business Strategy*

## **“Best of Class Supplier”**

### **Technology Leadership**

- ✍ Development of leading-edge products for focused markets
  - Highest Density
  - Fastest Speed
  - Lowest Power
  - Special Width or factors
- ✍ Advanced Manufacturing
  - Cost Competitiveness
  - Output Expansion

### **Best Sales Practices**

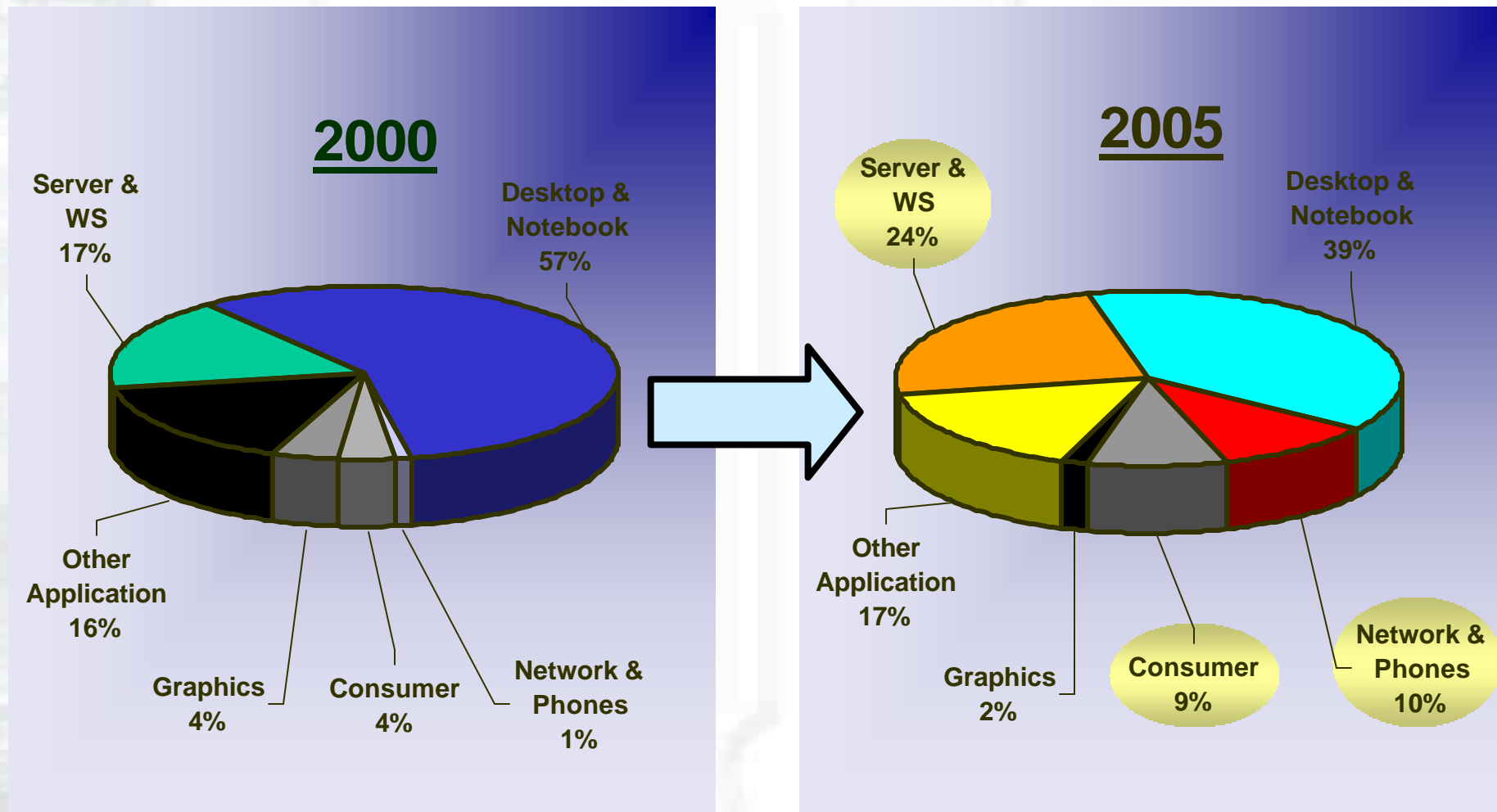
- ✍ Form Long-Term Customer Support Agreements
- ✍ Customer-Dedicated Technical Marketing Teams
- ✍ Best Global Efficiency
  - Organization
  - Logistics
  - Information Technology



# *DRAM Market Trend*

# ***DRAM Market Segments***

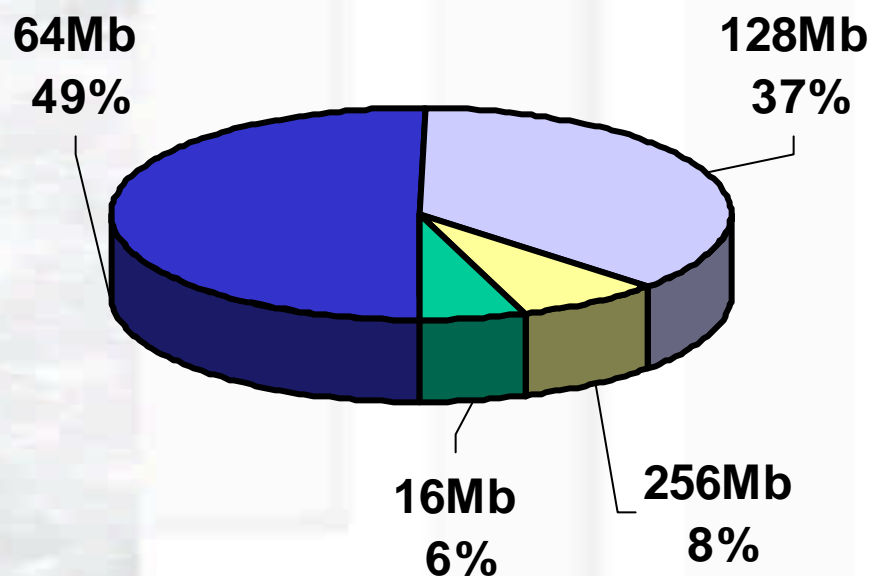
## ***Forecasting a Changing DRAM Market***



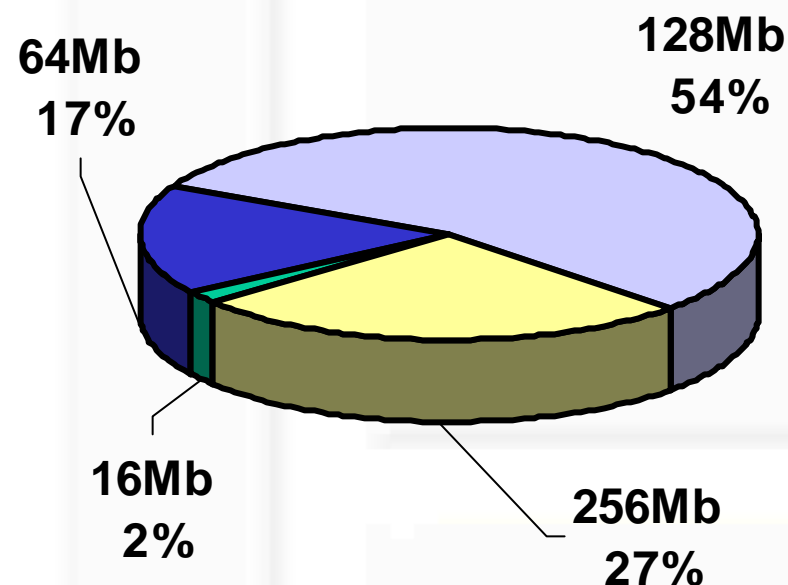
**Note: above charts reflect % of total bits**

# ***DRAM Density Supply***

**2000**

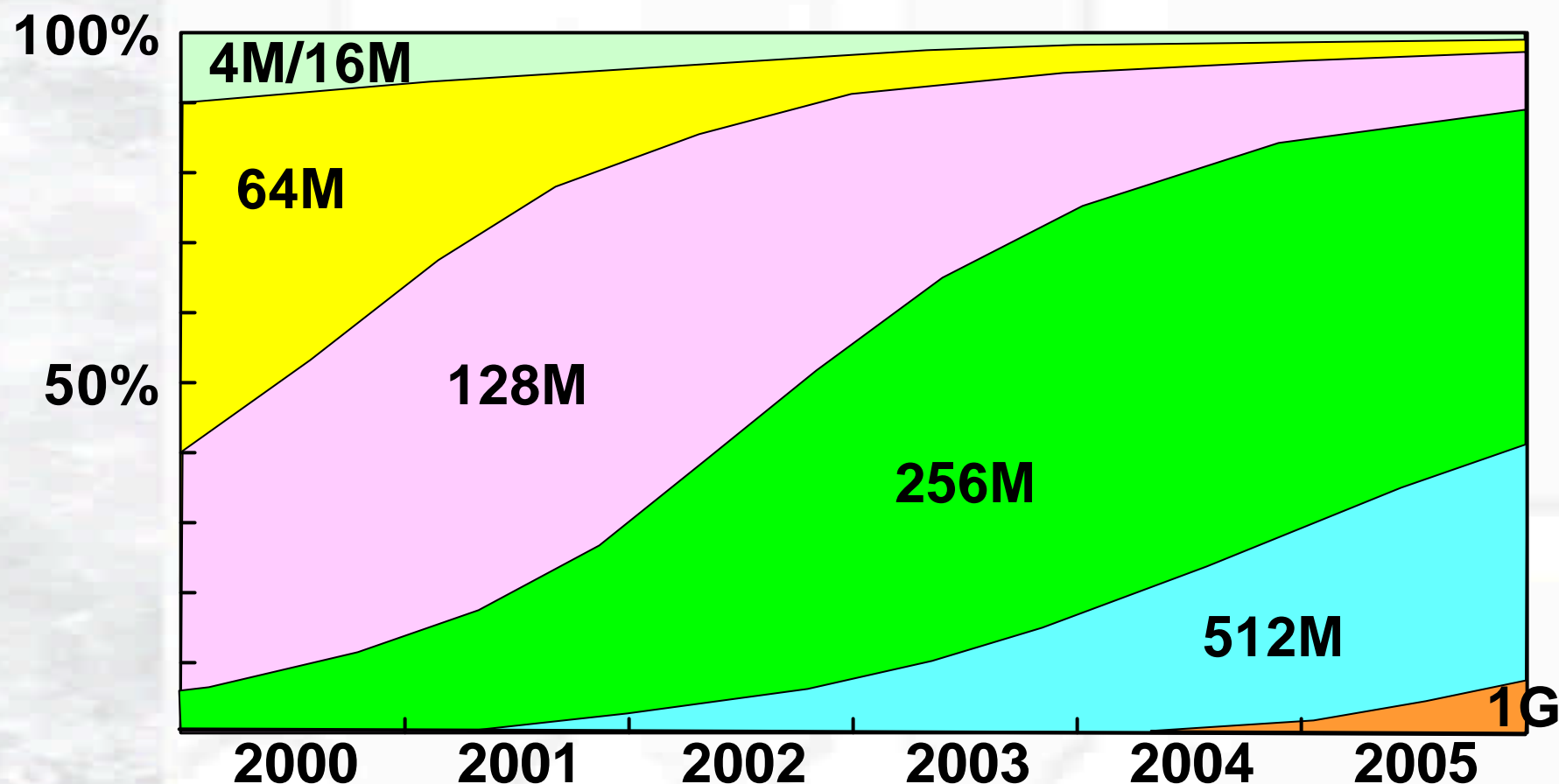


**2001**



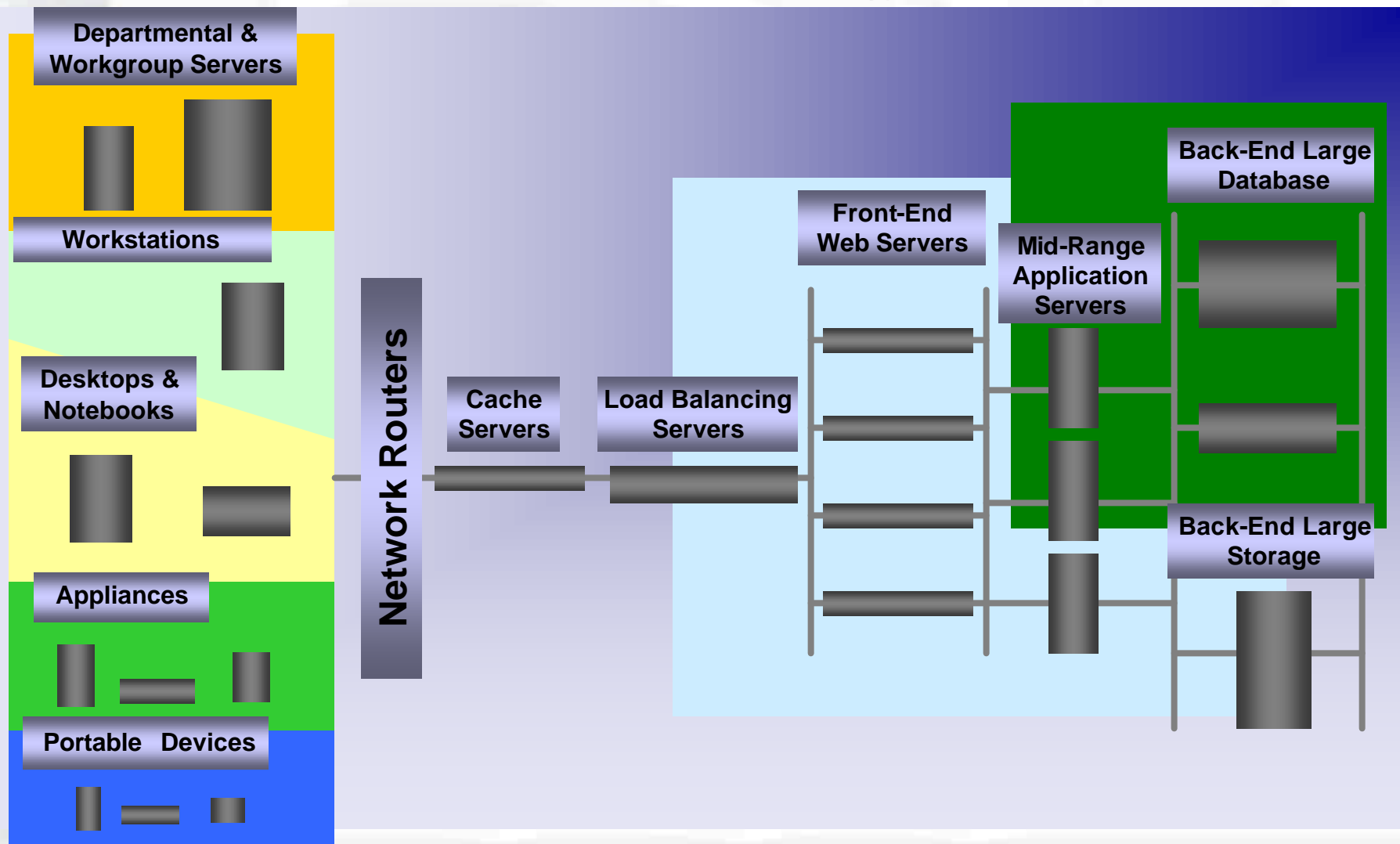
Source: IDC Preliminary

## *Product Mix Forecast ( Density )*

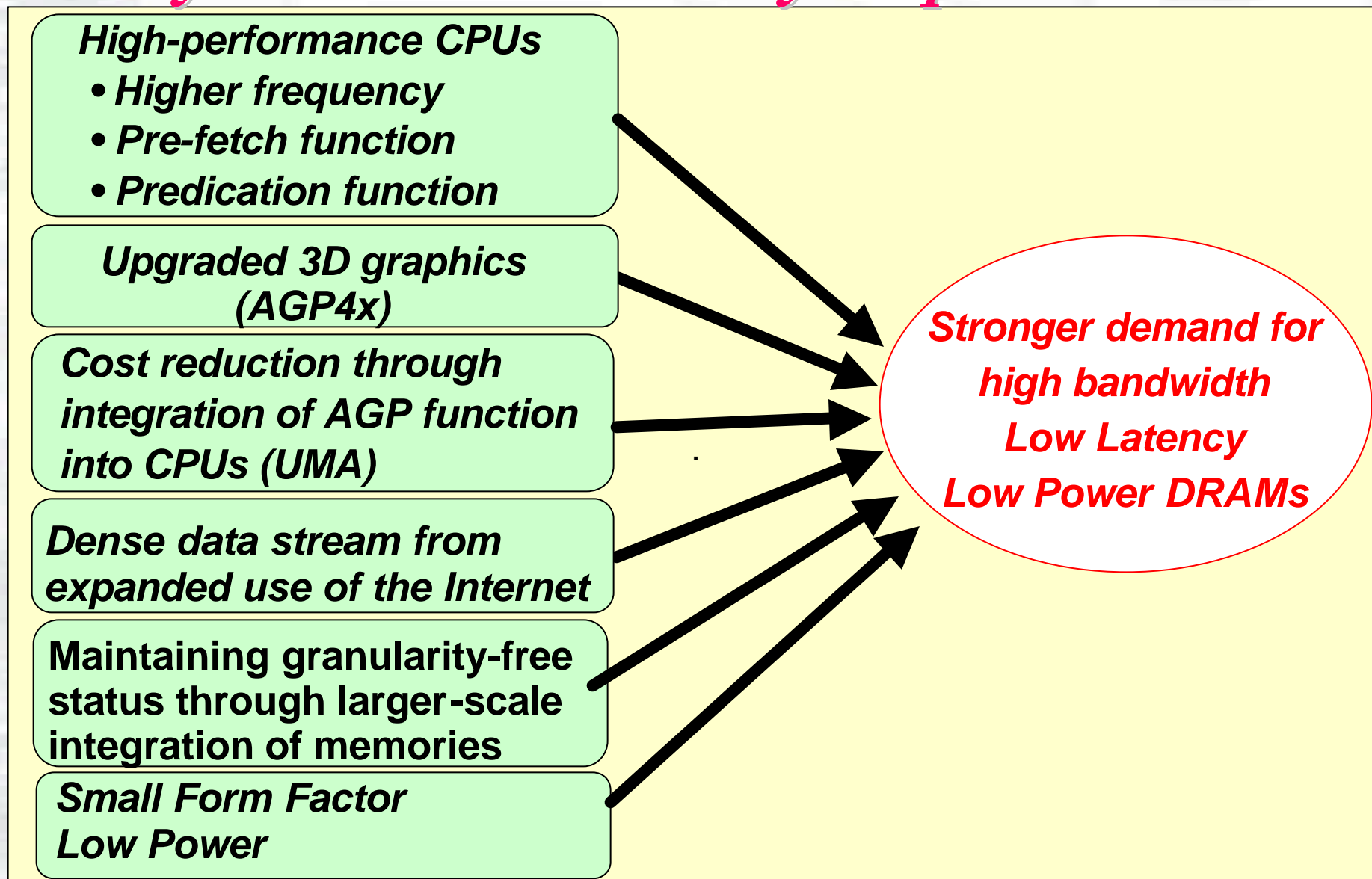


# *Tomorrow's Infrastructure*

## *Diverse Hardware Form Factors & Roles*














## ***System-Based Memory Requirements***

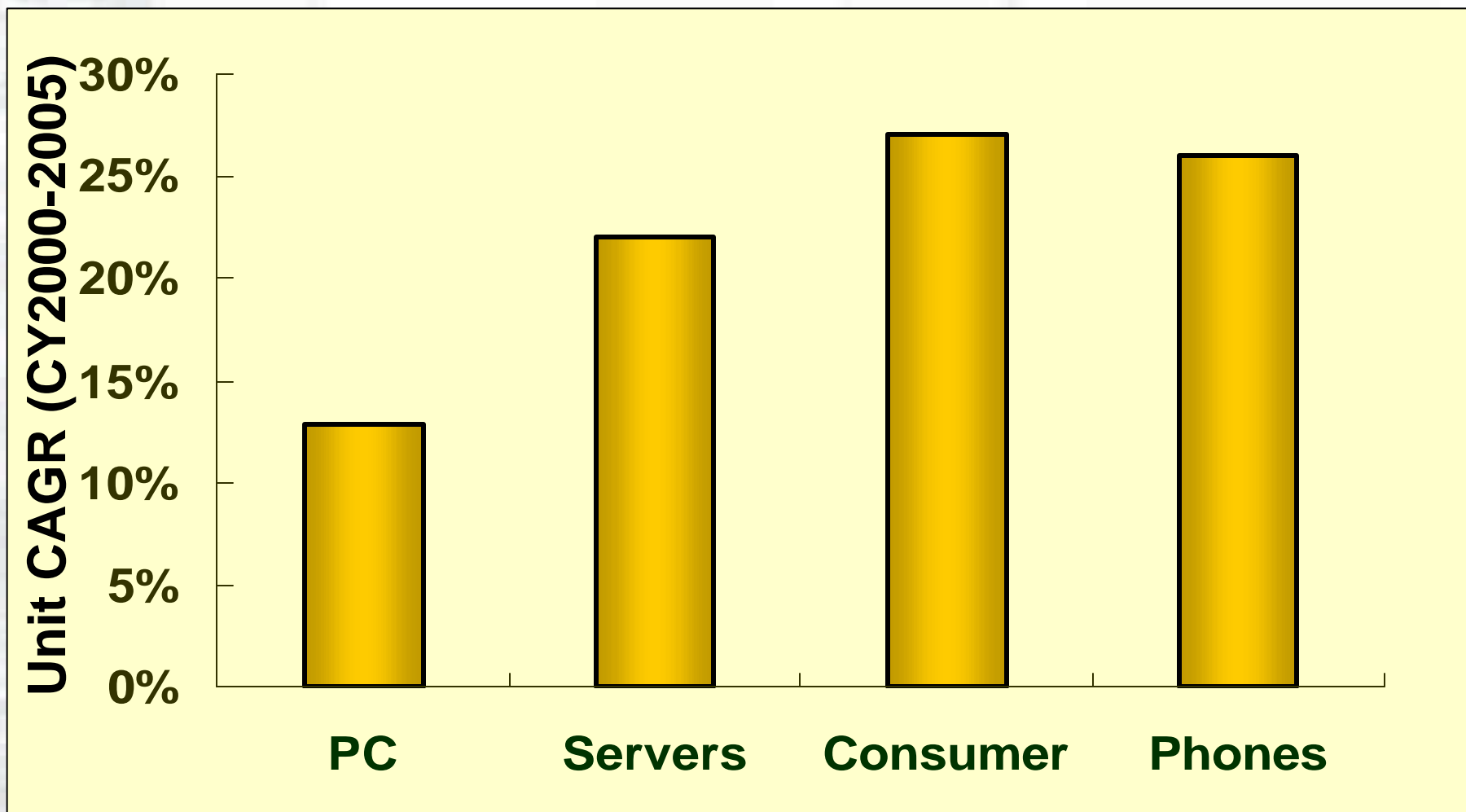


# **Emerging Software Applications**

***Stimulated By Need to Communicate Effectively & Efficiently***

-  Business Intelligence
-  ERP
-  Supply Chain Management
-  OLTP
-  E-Commerce
-  Message Transactions
-  Caching
-  Streaming Media
-  3D Animation & Rendering
-  Video Editing & Composition
-  Voice Recognition

# *Shifting System Unit Demand* *Internet Infrastructure & Client Driven*

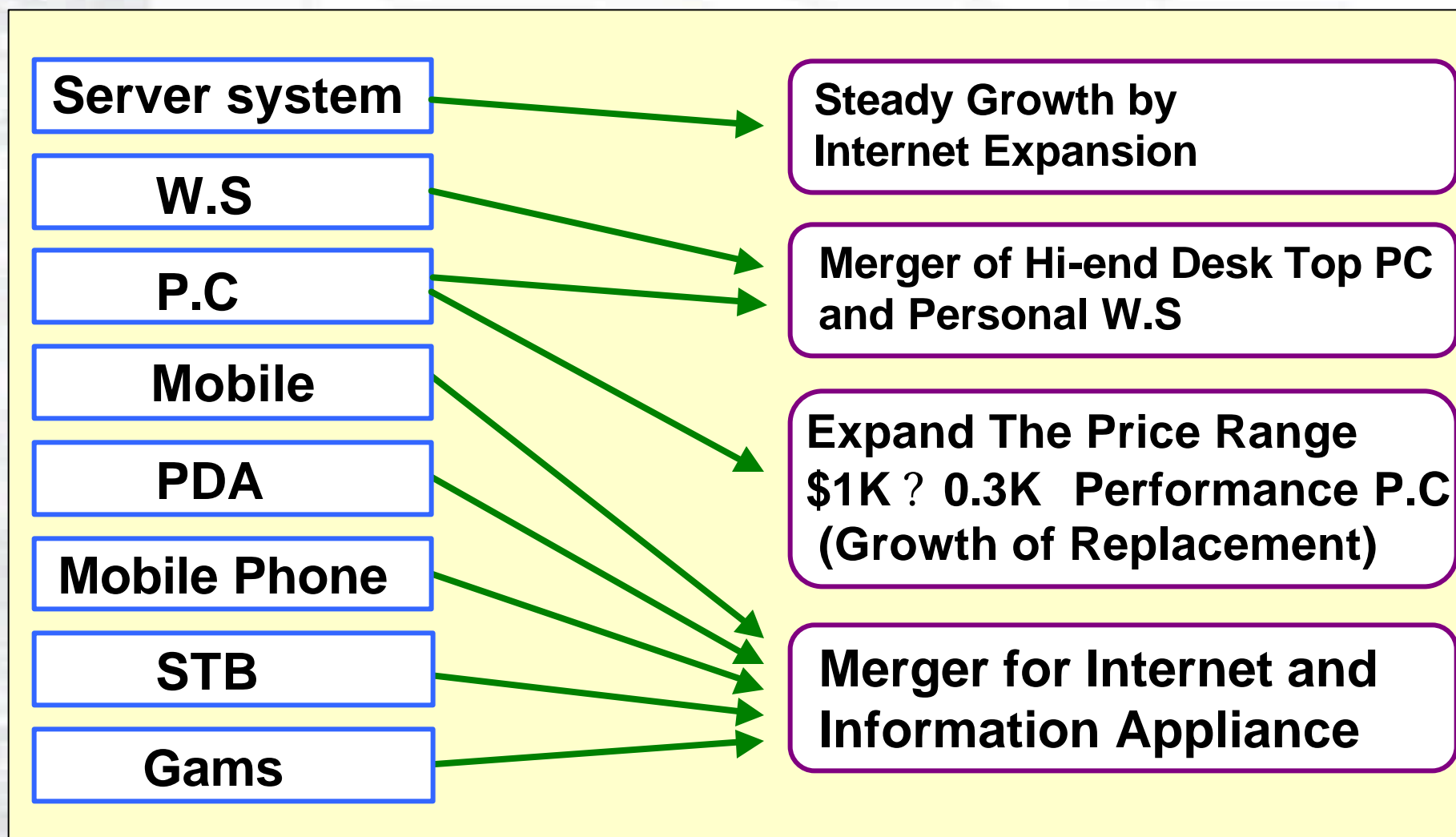




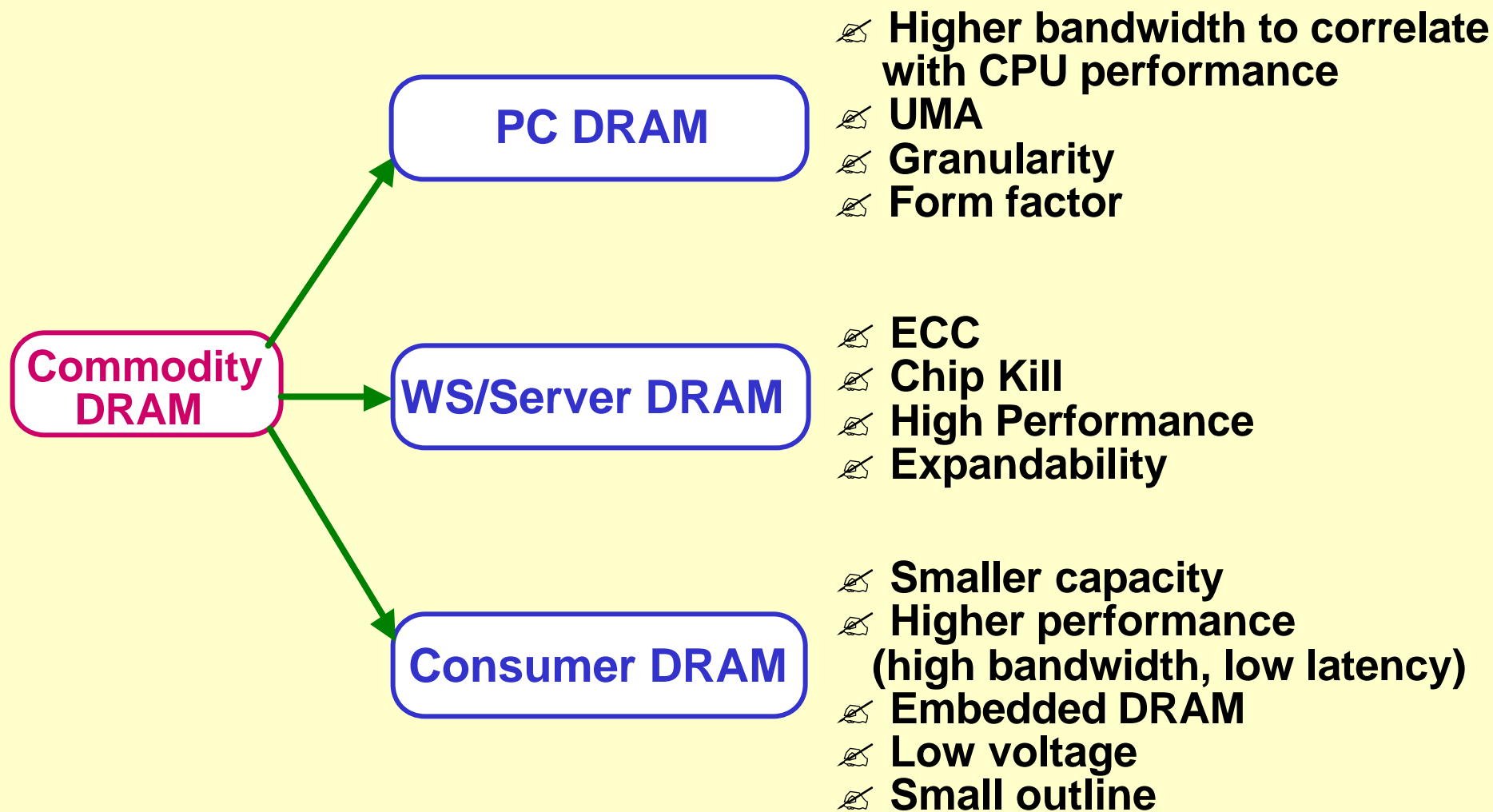
# *Memory Capacity Requirement For Multimedia Information*

	64M bit	1G bit	16G bit	64G bit
letter	4 M	64M	1 B	4 B
News Paper (one Page)	250	4,000	64,000	256,000
MP - 3 Compression: 1/10	5m33s	1h26m	23h9m	92h3m
MPEG1 Video Compression: 1/80	43s	11m	2h58m	11h2m
MPEG2 Video Compression: 1/20	13s	3m20s	53m20s	3h33s

## *Memory System Trend*



# ***DRAM Variation***



# *DRAM Technology Trend*

# *Memory System Requirements*

## *For Tomorrow's Systems and Applications*

### **DRAM Technology Improvements**

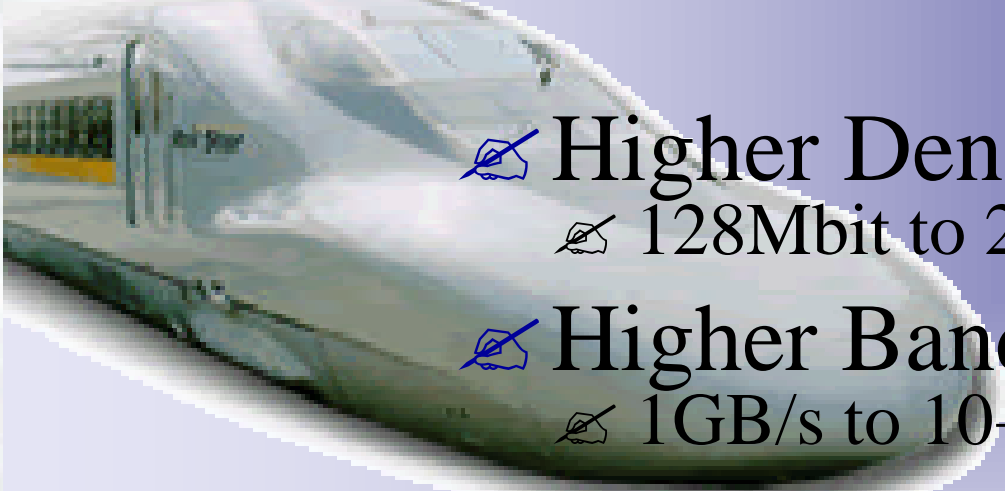








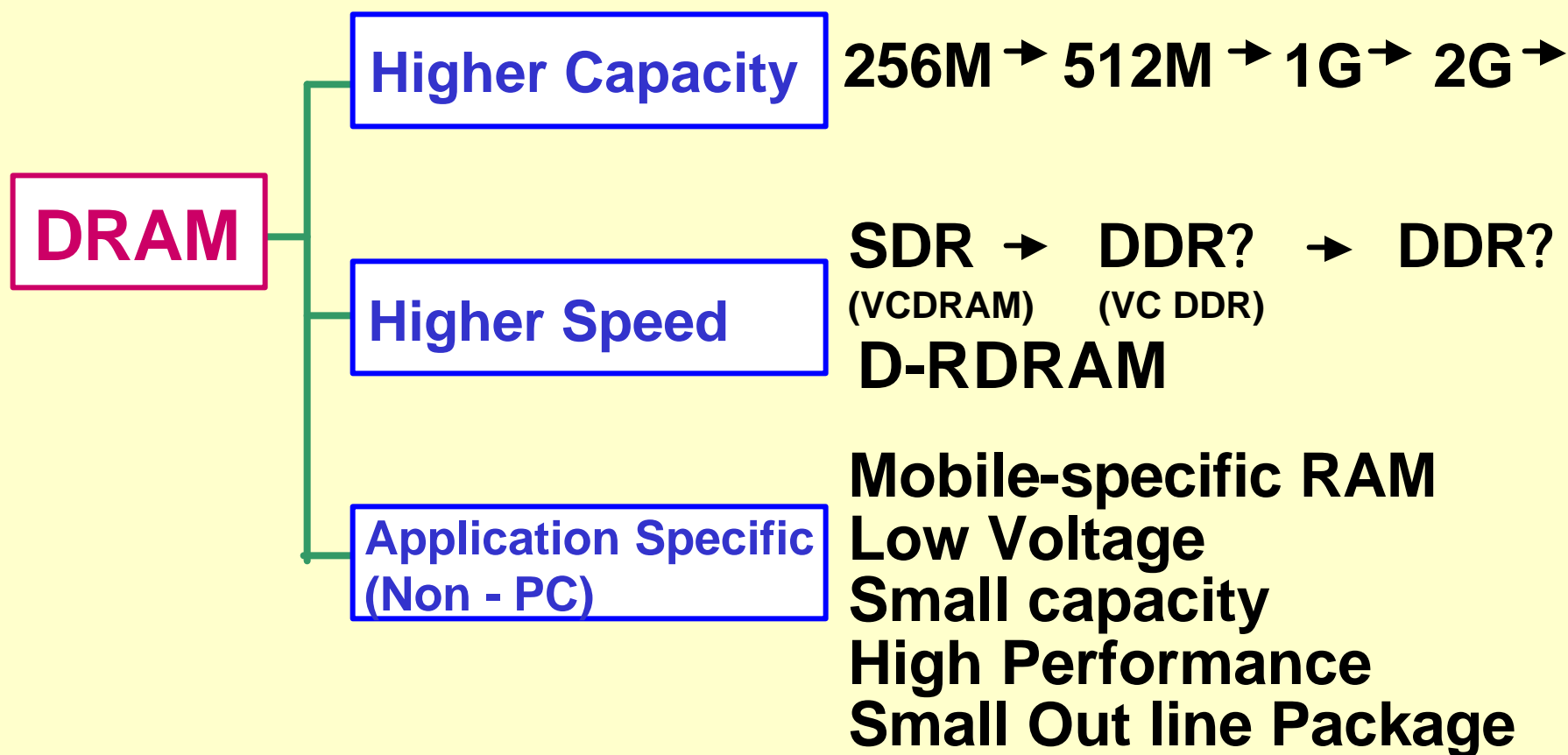
- 
-  Higher Density
    -  128Mbit to 2Gbit
  -  Higher Bandwidth (speed)
    -  1GB/s to 10+GB/s
  -  Lower Latency & Power
    -  3.3V to 1V
  -  Special Form Factors
    -  Stacked packaging, LP DIMMs, etc.

Photo Source: West Japan Railway Company

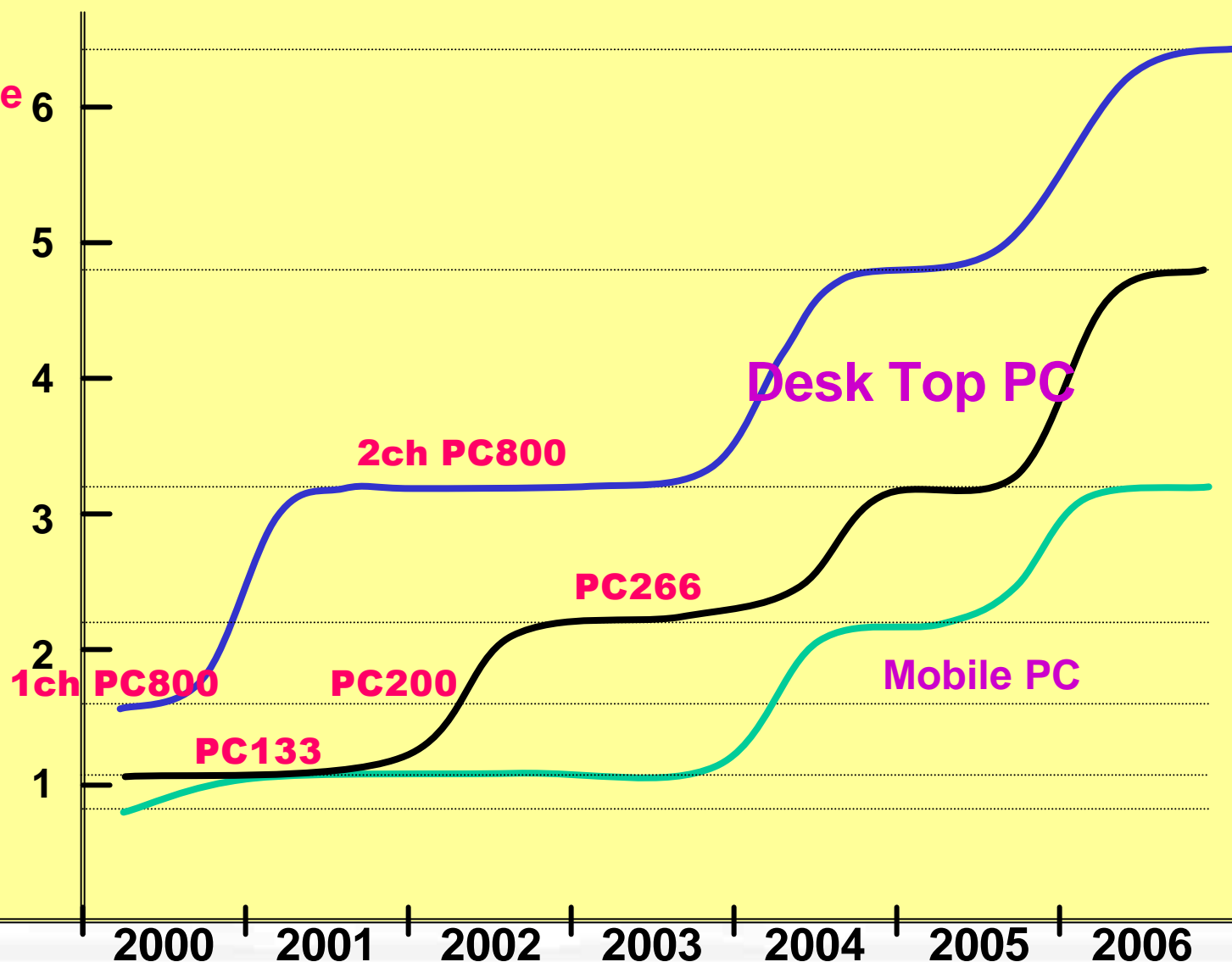
# *Future DRAM Development*

## **—— DRAM Technology Migration ——**

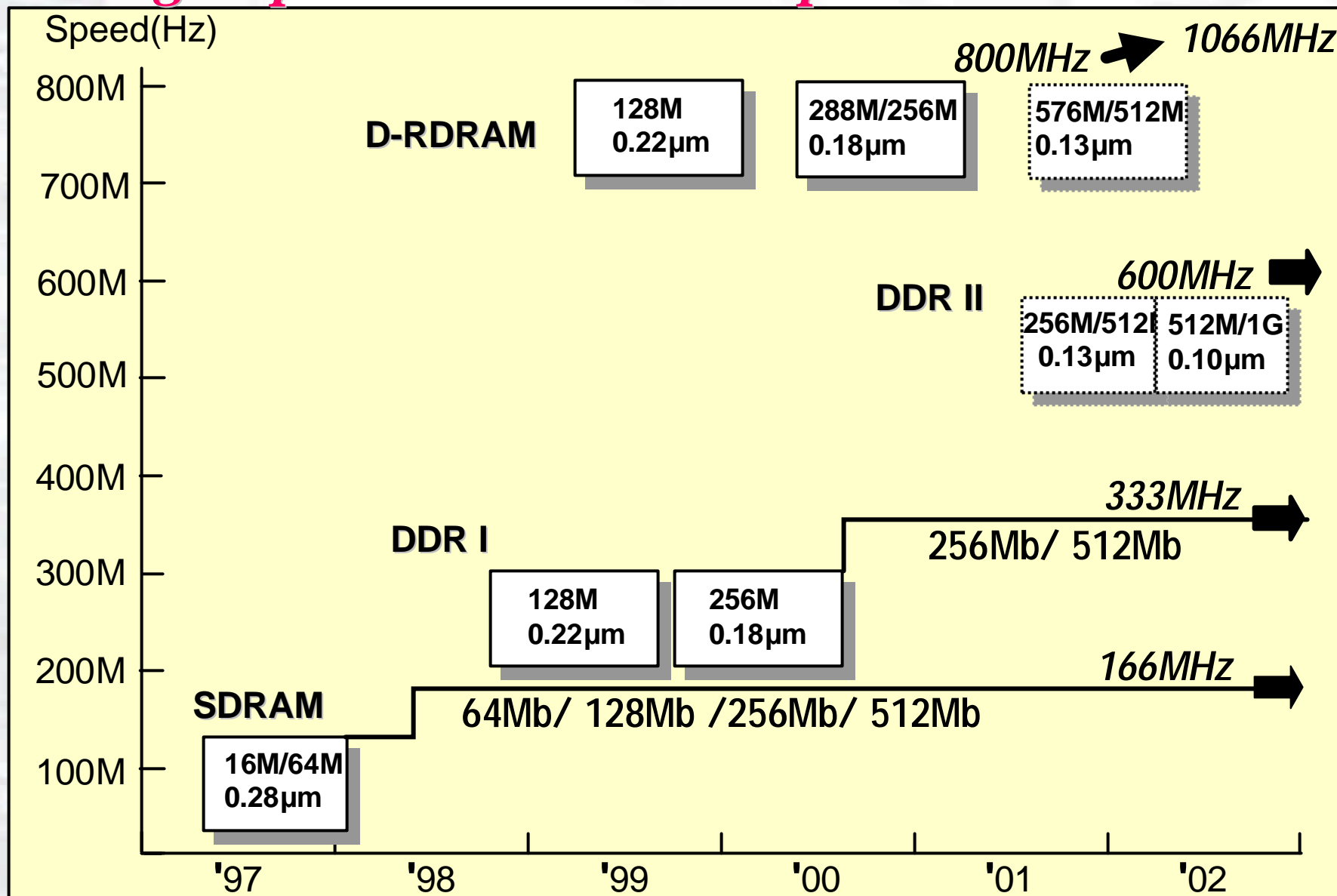


# *PC System Performance Movement*

System  
Performance  
(GB/s)



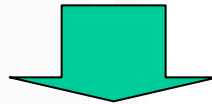
# High Speed DRAM Development Overview



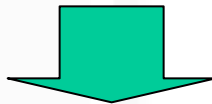


# ***Higher DRAM Technology Barrier***

**Process Driven Shrink Development  
(Lithography Driven)**



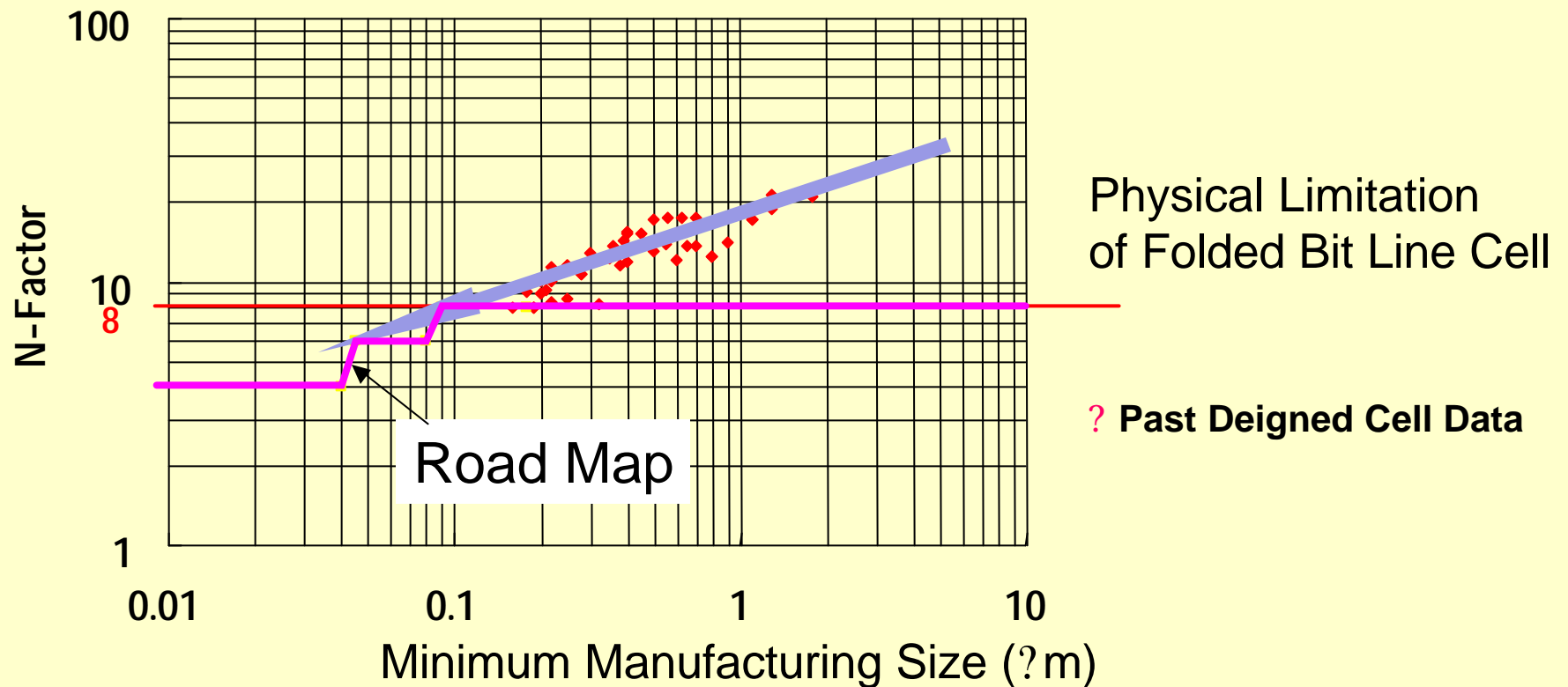
**Limitation of Physical Shrink by Lithography Improvement  
Limitation of 8F2 Cell(Manufacturing Size Limitation)  
Small Die Size Achievement Needs Total Technology**



***Beginning of New Competition Age By Technology Differentiation***

## Cell Factor Trend


**Normalized Cell Area by Minimum Manufacturing Size**  
 $\text{Cell Area} = N \times F (\text{Minimum Manufacturing Pitch}/2)^2$



*Small Die Requires The New N-Factor (ie  $6F^2$ )*

# *High Technology Portfolio*

## *Elpida Key Products*

- 
- ✍ Higher Density
    - Modules (TCP) & Discrete (DDP)
  - ✍ Higher Bandwidth (speed)
    - DDR & RDRAM
  - ✍ Lower Latency & Power
    - VCM
  - ✍ Special Form Factors
    - Discrete (MCP)

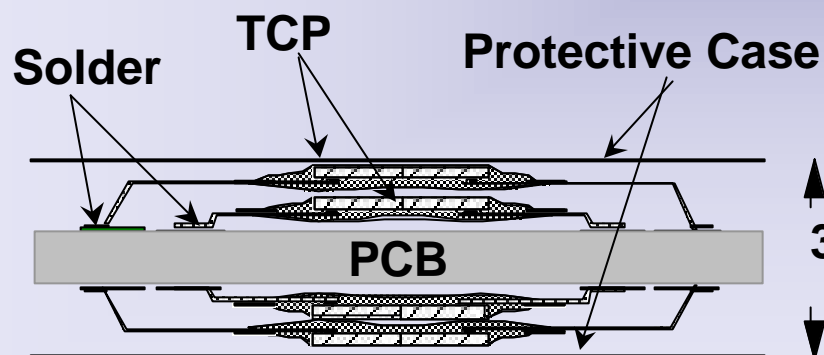
Source: West Japan Railway Company

# High Density Module Products Technology Overview

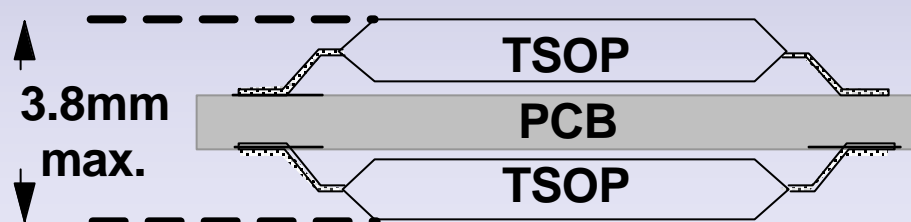
## TCP (Tape Carrier Package)

- ✍ Enables more density per DIMM, up to 72 pcs for 256Mb SDR or 36 pcs for 256Mb DDR
- ✍ Supports JEDEC Standards, including 168-pin 8 byte SDR DIMM, 144-pin 8 byte SDR SODIMM, 3.3 module

**Cross Section of Stacked TCP SODIMM**



**Cross Section of TSOP based SODIMM**



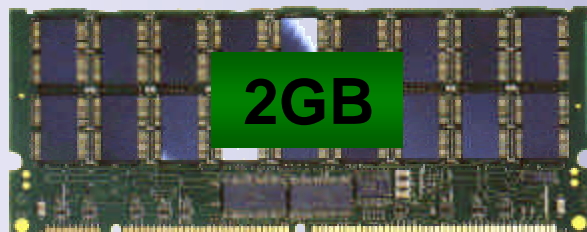
# High Technology Portfolio

## Product Availability

	CY01/1H	CY01/2H	CY02/1H	CY02/2H
TCP	1-2GB SDR & 1GB DDR based on <u>256Mb</u>			
	Highest Density		2-4GB 512Mb-based	
	512MB-1GB SDR based on <u>256Mb</u>			
	1U Rack Server		Note: DDR currently under study	
	1-2GB 512Mb-based			
	512MB SDR or DDR based on <u>256Mb</u>			
	SODIMM		1GB	
	128MB SDR or DDR based on <u>256Mb</u>			
	Micro-SODIMM		256MB	

# High Density Module Products

## TCP SDR & DDR Registered DIMMs



(72 pcs 256Mb SDR)

2.10 in.  
height

Note: 1.70 in. for 0.15um

✍ For Memory-intensive Servers & Workstations



(36 pcs 256Mb SDR)

1.50 in.  
height

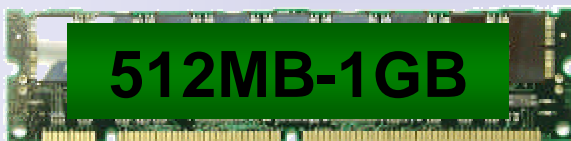
✍ Effective solution for Mainstream Servers & WS



(36 pcs 256Mb DDR)

1.70 in.  
height

✍ High-density solution for next-generation high bandwidth Servers & WS



(36 pcs 256Mb SDR)

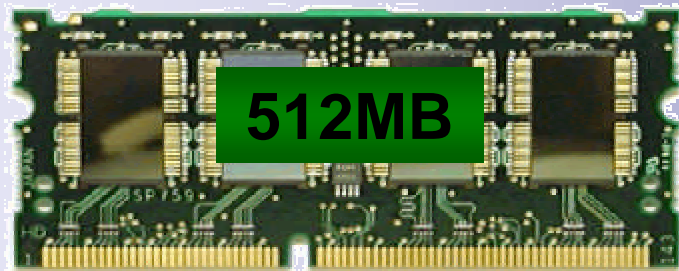
Note: DDR currently under study

1.20 in.  
height

✍ For 1U rack servers or space-limited form factors

# *High Density Module Products*

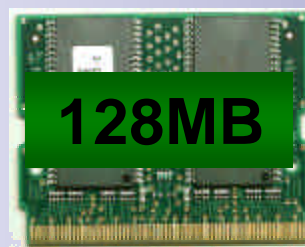
## *TCP SDR & DDR SODIMMs*



1.25 in.  
height

2.66 in. width  
(16 pcs 256Mb SDR or **DDR**)

✍ For high-performance notebooks



1.18 in.  
height

1.50 in. width  
(4 pcs 256Mb SDR or **DDR**)

✍ For sub-notebooks & handheld PCs



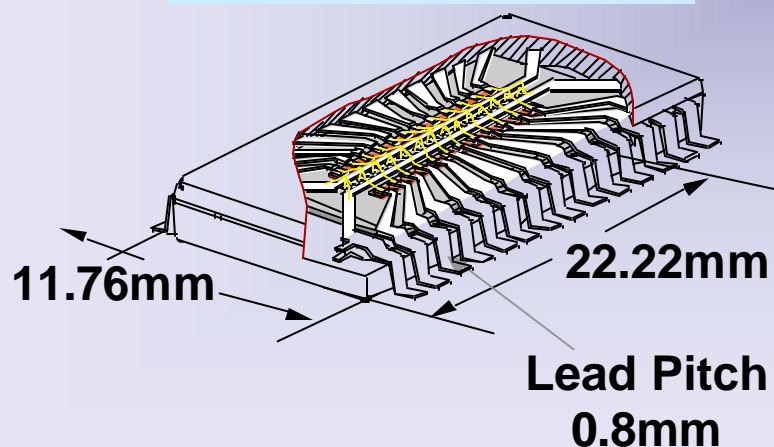
# High Density Discrete Products

## Technology Overview

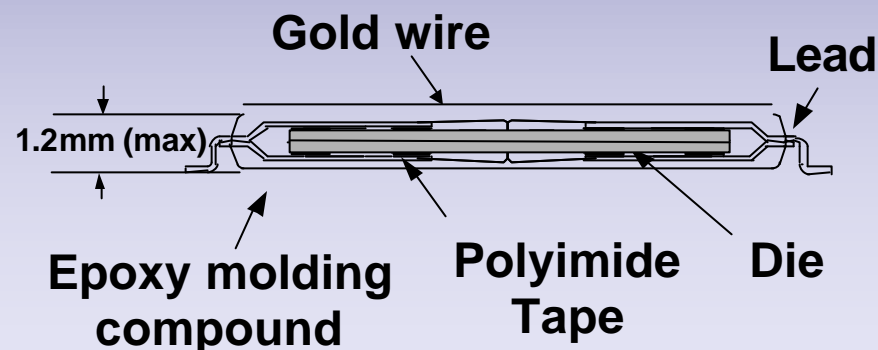
### DDP (Double Density Package)

- ✍ Enables 512Mb SDR discrete by packaging two 256Mb chips in a standard 54-pin TSOP package
- ✍ Same footprint as standard 256Mb SDR TSOP

**Dimensions of SDR TSOP using DDP**



**Cross Section of TSOP using DDP**





# *High Technology Portfolio*

## *Product Availability*

	CY01/1H	CY01/2H	CY02/1H	CY02/2H
<b>DDP</b>	128Mb SDR (2 pcs of 64Mb SDR)			
	512Mb SDR (2 pcs of 256Mb SDR)			
	1Gb SDR 512Mb-based			

# *High Bandwidth Memory*

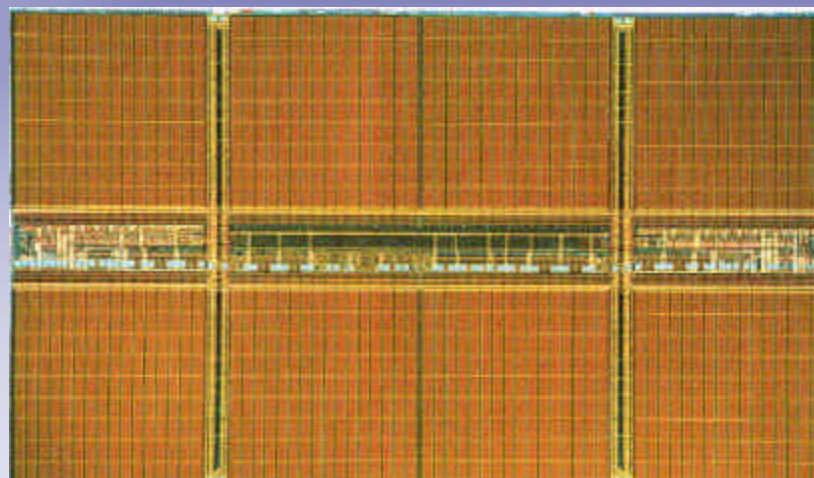
## *RDRAM*

### Elpida Leadership

- ✍ 1st of 3 Suppliers to validate 288Mb component (Nov-29-00)
- ✍ 1 of 3 Suppliers RIMM validated on Intel 850 (Dec-13-00)
- ✍ 1 of 3 suppliers to reach Rambus production milestone
- ✍ Targeting Workstations, performance desktops
- ✍ Aggressively pursuing further cost reduction

### 288Mb RDRAM (0.18um)

**PC800 = 3.2GB/sec**  
**(2-channel system)**



**Source: Intel Web Site, Rambus Web Site**

# *High Technology Portfolio*

## *Product Availability*

	CY01/1H	CY01/2H	CY02/1H	CY02/2H
<b>RDRAM</b>	64-576MB PC600-800 RIMM (288Mb-based)			
	288Mb PC600-800 Mono for RIMM & Scalable Systems			
	128MB-1GB PC800 512Mb-based			

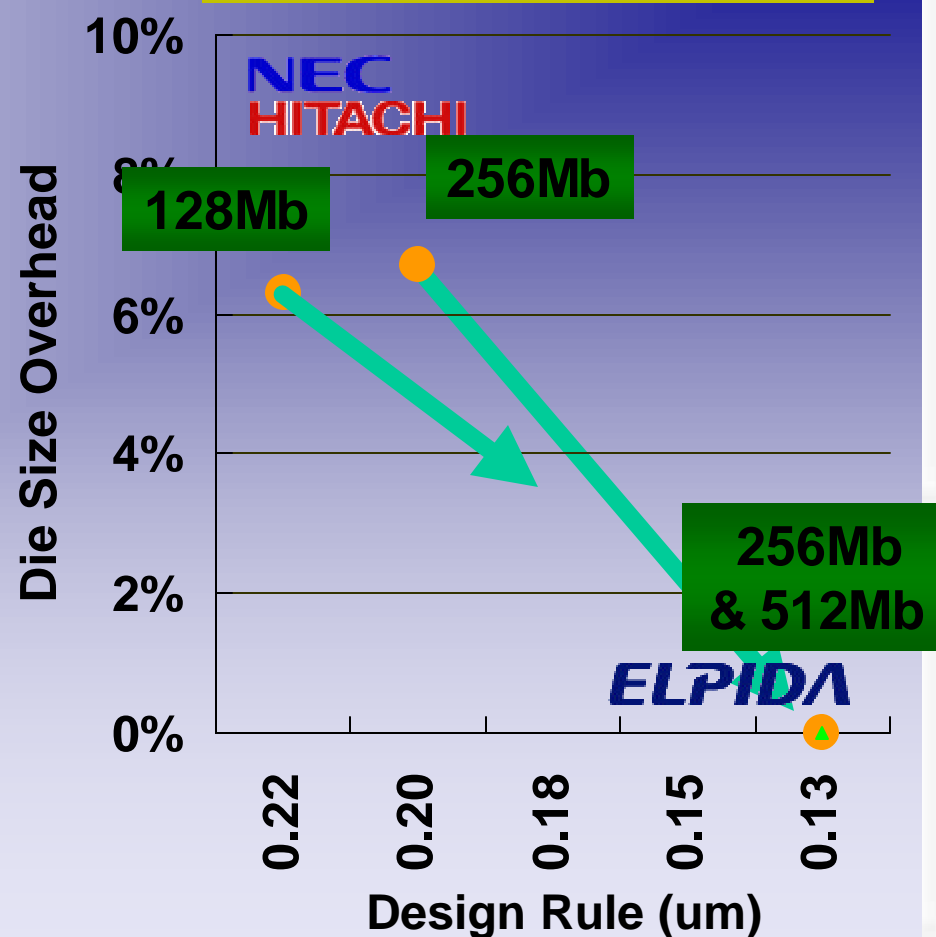
# High Bandwidth Memory

## DDR

### Summary

- ✍ Cost-effective High Bandwidth solutions
  - ✍ Enabling high-performance speed at 333MHz
  - ✍ Ensuring lowest cost with same die implementation
  - ✍ Targeting Servers, WS, Performance PCs
  - ✍ Evaluating DDR in low power applications

### DDR vs. SDR OH



# *High Technology Portfolio*

## *Product Availability*

	CY01/1H	CY01/2H	CY02/1H	CY02/2H
DDR	128Mb, 64-256MB Unbuf., 128-256MB Reg. 200-266MHz			
	256Mb, 256-512MB Unbuf., 512MB Reg., 256MB SODIMM			
	512Mb & Modules 333MHz 512Mb-based			

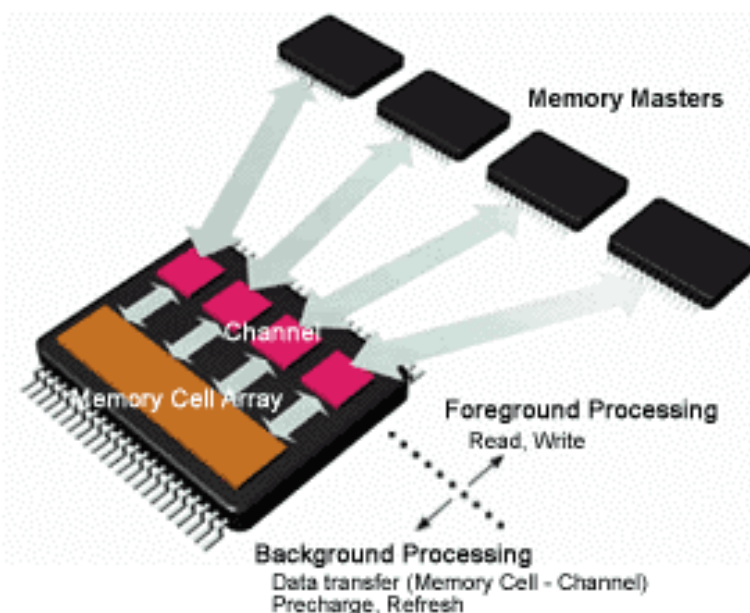
# *Low Latency & Power Memory*

## *128Mb VCM-based Products*

### Product Summary

- High performance memory alternative to PC133
- Cost-effective; same price to OEM as 128Mb SDR
- Offered in module and discrete form
- Guaranteed support from Elpida for all customers within two year timeframe
- Target Via-based systems & multi-tasking or low power consumption designs

### High Data Transfer Efficiency



Internal operations such as precharge & refresh can be performed in parallel with read & write operations from outside memory. Data required for next access can also be prepare in advance. This parallel processing effectively reduces wait time during random access.

# *High Technology Portfolio*

## *Product Availability*

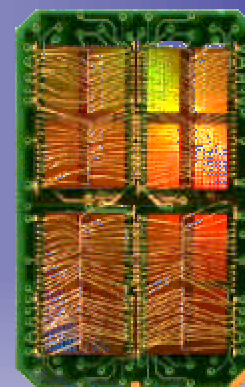
	CY01/1H	CY01/2H	CY02/1H	CY02/2H
VCM	<p>128Mb, 64-256MB Unbuf., 64-128MB SODIMM 133MHz CL2</p> <p>256Mb &amp; Modules 256Mb-based</p>			



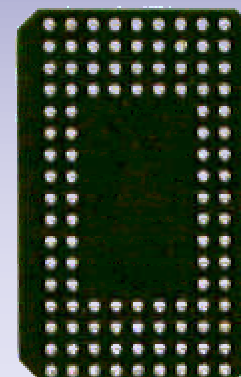
# *Wide Discrete Products Technology Overview*

## **MCP (Multi-Chip Package)**

- ✍ Enables x32-bit & x64-bit discrete solutions
- ✍ Packaging
  - MC-BGA: standard 108-pin
  - MC-FBGA: standard 90-pin
- PC100 compatible
- ✍ Targeting Consumer-type & Wide-Memory systems
  - DSC, Mobile, Hand-held, Telecom equipment



**4 pieces  
64Mb Die**



**Standard  
Packaging**

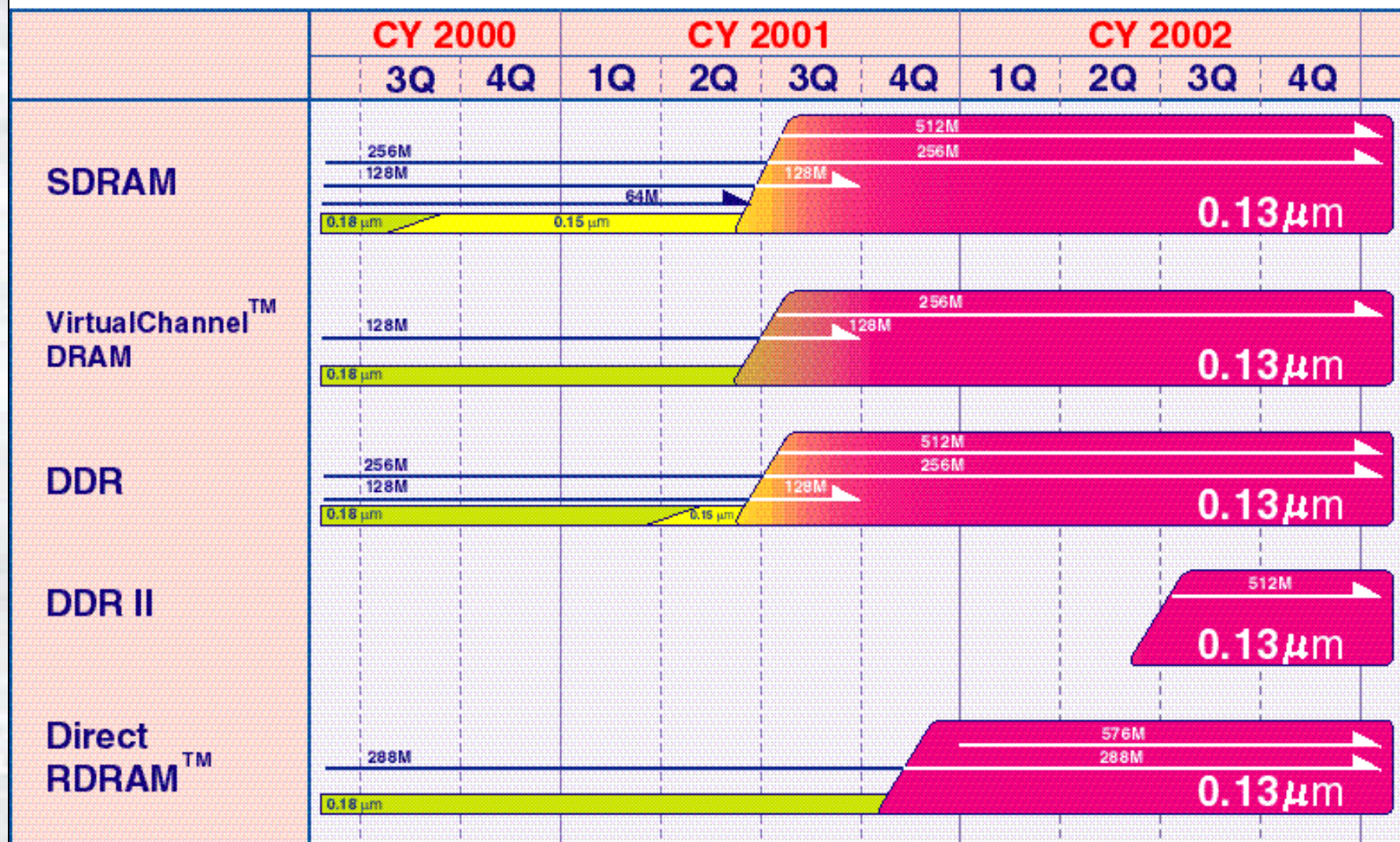


# *High Technology Portfolio*

## *Product Availability*

	CY01/1H	CY01/2H	CY02/1H	CY02/2H
<b>MCP</b>	128Mb x32 (2 pcs 4Mx16)			
	256Mb x32 (4 pcs 8Mbx8)			
	256Mb x64 (4 pcs 4Mbx16)			
	512Mb x32 (2 pcs 16Mx16Mb)			
	1Gb x32 (2 pcs 512Mb 0.13um)			

## Products Roadmap

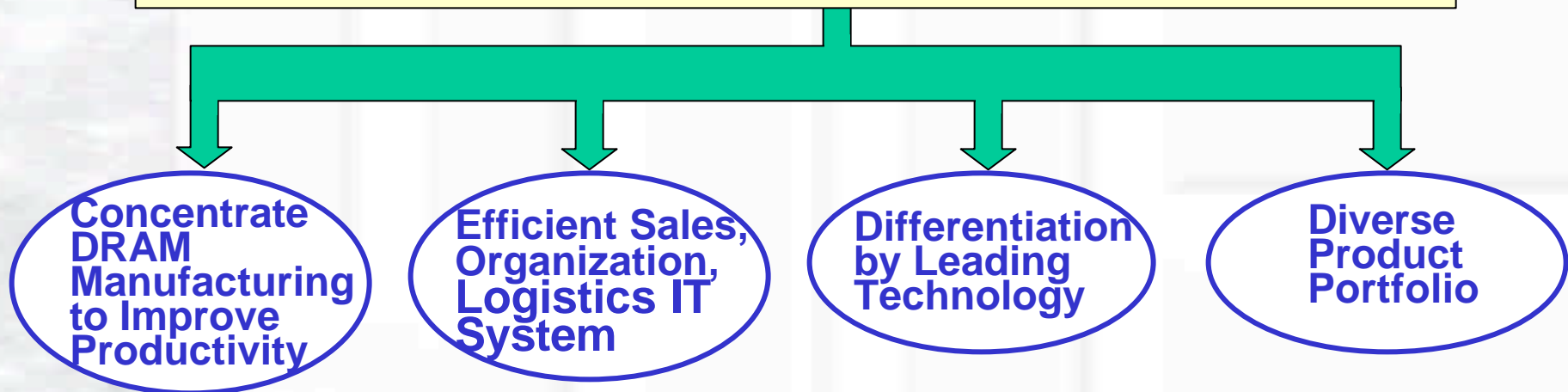


Direct RDRAM is a trademark of Rambus Inc. VirtualChannel is a trademark of NEC Corporation.

## *Conclusion*

### *Elpida Memory Inc.*

- **Concentrated DRAM Business**
  - Product development
  - Design resource
  - Capital investment
  - Manufacturing Site
- **Establish lowest Cost Structure**



***Top DRAM Supplier in Advanced Technology  
Product with Strong Cost Competitiveness***

**<http://www.elpida-memory.com>**

**Thank You**